

Before the  
**FEDERAL COMMUNICATIONS COMMISSION**  
Washington, DC 20554

In the Matter of	)	
	)	
Expanding Flexible Use in Mid-Band	)	GN Docket No. 17-183
Spectrum Between 3.7 and 24 GHz	)	

To: The Commission

**COMMENTS OF  
THE BOEING COMPANY**

The Boeing Company (“Boeing”) provides these comments in response to the Commission’s Notice of Inquiry (“NOI”) on expanding flexibility for wireless systems in frequency bands between 3.7 and 24 GHz.

Boeing is a world-leading developer and manufacturer of aeronautical and satellite systems, both of which are dependent on reliable, protected, global spectrum allocations. Boeing strongly supports the comments of the Satellite Industry Association (“SIA”) that satellite communications networks operating on a paired basis in the 3.7-4.2 GHz and the 5.925-6.425 GHz bands must be protected from harmful interference.<sup>1</sup> Boeing is filing these separate comments to bring to the Commission’s attention another critical issue implicated by the NOI, the public safety importance of ensuring that aeronautical communications and safety services operating in the frequency band 4.2-4.4 GHz are protected from harmful interference resulting from high density fixed and mobile operations in the immediately adjacent 3.7-4.2 GHz frequency band.

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<sup>1</sup> As the NOI acknowledges, satellite networks support critically important communications links used for public safety, disaster relief, banking and commerce, and the distribution of video programming, news and information to broadcast television stations, cable network head ends, and to individual consumers through direct-to-home services worldwide. See NOI, ¶¶ 8, 14.

The NOI seeks comment on whether the 3.7-4.2 GHz band could accommodate “more intensive” fixed use of the band for fixed point-to-multipoint and last-mile point-to-point operations.<sup>2</sup> The NOI also seeks comment on whether it would be possible to accommodate high density mobile operations in the 3.7-4.2 GHz band.<sup>3</sup> With respect to both issues, the NOI appropriately considers the significant incumbent uses of the 3.7-4.2 GHz band, such as satellite communications services, and the importance of protecting their continued reliable operations. The NOI, however, does not consider other critically important spectrum uses that either currently exist or are being deployed in the frequencies immediately adjacent to the 3.7-4.2 GHz frequency band, namely aircraft radio altimeters and wireless avionics intra-communications (“WAIC”) systems, both of which are critical to aviation safety and are authorized pursuant to co-primary allocations in the 4.2-4.4 GHz band. As discussed below, it is essential that any high density fixed or mobile services that are permitted by the Commission to operate in the 3.7-4.2 GHz band be restricted sufficiently to ensure radio altimeters and WAIC systems are protected adequately from harmful interference.

## **I. THE COMMISSION MUST ENSURE THE PROTECTION OF THE FLYING PUBLIC AND THE SAFE OPERATION AND LANDING OF AIRCRAFT**

The 4.2-4.4 GHz band is allocated globally to the aeronautical radionavigation service for the exclusive use of radio altimeters.<sup>4</sup> Radio altimeters are an essential component of the safe operation of aircraft, supporting precision approach, landing, ground proximity, and collision

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<sup>2</sup> *Id.*, ¶ 18.

<sup>3</sup> *See id.*, ¶ 19.

<sup>4</sup> *See* 47 C.F.R. § 2.106, notes 5.438 and US261 (indicating that “[u]se of the band 4200-4400 MHz by the aeronautical radionavigation service is reserved exclusively for radio altimeters installed on board aircraft and for the associated transponders on the ground”).

avoidance systems.<sup>5</sup> Radio altimeters transmit radio signals toward the ground and, by calculating the time it takes for the signals to be reflected back to the aircraft receiver, determine the aircraft's height above ground.<sup>6</sup> Because speed, distance, and time are all related to each other, the altimeter can accurately determine the altitude of the aircraft. All commercial aircraft are equipped with and operate radio altimeters continually during flight (larger aircraft simultaneously operate two or three radio altimeters) wherever the aircraft travels.<sup>7</sup> The data provided by radio altimeters is used as a height controlling sensor by the Automatic Flight Control System during automated approaches and landings.<sup>8</sup> In many aircraft, the radio altimeter is also directly connected to the Ground Proximity Warning System, which is designed to warn the pilot if the aircraft is flying too low or descending too quickly.<sup>9</sup>

Radio altimeters require access to the entire 4.2-4.4 GHz band because the accuracy of the resulting altitude data is directly related to the total bandwidth of the radio altimeter signal.<sup>10</sup> Most radio altimeters operate at relatively low power,<sup>11</sup> which creates a potential interference concern with respect to ground-based radio transmitters operating at or near the 4.2-4.4 GHz band. Such ground-based transmitters could direct sufficient power in an upwards direction to

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<sup>5</sup> See Operational and technical characteristics and protection criteria of radio altimeters utilizing the band 4 200-4 400 MHz, Recommendation ITU-R M.2059-0, at 1, 3 & 5 (2014).

<sup>6</sup> See *id.* at 5.

<sup>7</sup> See *id.* at 11.

<sup>8</sup> See *id.* at 5.

<sup>9</sup> See *id.*

<sup>10</sup> See *id.* at 11 (explaining that “radio altimeters operate in wide bandwidths to achieve the necessary accuracy levels” and therefore any reduction in the available frequency bandwidth “proportionately reduces the accuracy of radio altimeters”).

<sup>11</sup> See *id.* at 12-17 (providing transmit power levels of different types of analog and digital radio altimeters).

overpower the relatively weak radio altimeter signals that have been reflected off the ground and thereby prevent their reception by radio altimeter receivers on aircraft. Although radio altimeters employ band pass filters, these filters have limited ability to reject transmissions close to the 4.2-4.4 GHz band.<sup>12</sup> As a result, altimeter performance may be affected adversely by undesired signals transmitted near the edge of the 4.2-4.4 GHz band.<sup>13</sup> The Commission must therefore proceed with utmost caution in considering allowing any high density fixed or mobile operations in the adjacent 3.7-4.2 GHz frequency band.

## **II. THE COMMISSION MUST ALSO ENSURE THE PROTECTION OF WIRELESS AVIONICS INTRA-COMMUNICATIONS SYSTEMS IN THE 4.2-4.4 GHZ BAND**

With the active support of the United States, the 2015 World Radiocommunication Conference (“WRC-15”) allocated the 4.2-4.4 GHz band on a global co-primary basis to the aeronautical mobile (route) service (“AM(R)S”) exclusively for WAIC systems.<sup>14</sup> WAIC equipment is being deployed on new aircraft to increase the safety and efficiency of their operations by using onboard short range wireless systems to replace a potentially substantial portion of aircraft wiring.<sup>15</sup> WAIC systems can help make aircraft safer by providing dissimilar redundancy in communications links between critical aircraft systems. WAIC systems can also

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<sup>12</sup> *See id.*

<sup>13</sup> *See id.*

<sup>14</sup> *See* ITU Radio Regulations No. 5.436 (indicating that use of the frequency band 4 200-4 400 MHz by stations in the aeronautical mobile (R) service is reserved exclusively for wireless avionics intra-communication systems that operate in accordance with recognized international aeronautical standards).

<sup>15</sup> *See, e.g.,* Presentation of the Aerospace Vehicle Systems Institute for Working Parties 5A, 5B, 5C, “Agenda Item 1.17 Wireless Avionics Intra-Communication” (May 23, 2012) (available at <https://www.itu.int/ITU-R/study-groups/docs/workshop-wp5abc-wrc15/WP5ABC-WRC15-P2-5.pdf>).

make aircraft more economical to operate because they weigh less than wiring. With the total weight of wiring and related fixtures on modern passenger aircraft often exceeding six tons, the substantial reduction in weight can improve fuel efficiency, thus providing environmental benefits and cost savings to aircraft manufacturers, operators and the flying public.

One of the significant advantages that was identified in support of allocating the 4.2-4.4 GHz band for WAIC systems was that this spectrum is already allocated for an aeronautical safety service<sup>16</sup> and the spectrum is not adjacent or nearly adjacent to any spectrum currently used for mobile consumer devices such as smartphones, laptops, and tablets, all of which are routinely carried by passengers on commercial aircraft. Currently, mobile consumer devices are not designed with the capability to transmit signals in or near the 4.2-4.4 GHz band. If, however, the Commission were to create an allocation for mobile wireless systems in the 3.7-4.2 GHz band, the global aviation industry would likely be forced to confront the substantial public safety problem of out-of-band emissions (potentially including emissions from consumer devices onboard the aircraft) impacting the safe operation of aircraft.

Given the critical public safety concern that would result from the operation of mobile wireless devices in spectrum adjacent or nearly adjacent to the global AM(R)S allocation for WAIC, Boeing recommends that any consideration of additional flexibility in the use of the 3.7-4.2 GHz band (or at least its upper portion) be regulated strictly to ensure that harmful interference does not result into WAIC receivers operating in the adjacent spectrum. Comprehensive technical studies would also be necessary to determine just how much of the upper portion of the 3.7-4.2 GHz band would need to be excluded from consideration for mobile

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<sup>16</sup> WAIC systems will not interfere with radio telemetry operations in the same spectrum because the significant attenuation of aircraft “skin” protects radio altimeters from the relatively low power WAIC transmissions inside the aircraft.

wireless devices to ensure that aircraft systems are protected adequately from harmful interference.

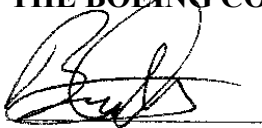
### **III. CONCLUSION**

Boeing recognizes the Commission's goal of identifying additional spectrum suitable for fixed point-to-point, point-to-multipoint, and mobile applications. The Commission, however, must ensure that any additional use of the 3.7-4.2 GHz band adequately protects aeronautical communication and safety systems operating in the adjacent 4.2-4.4 GHz band. Boeing also concurs with the positions of SIA in the need to protect critically important satellite communications services in the 3.7-4.2 GHz band.

Respectfully submitted,

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